

1. In the field of audio communication, a steganographic method for embedding
data, comprising the steps of:
a first step of inputting a digital host audio signal;
dividing said host audio signal into non-overlapping frames;
computing the frame power f_e ;
a second step of inputting a digital signal to be embedded;
determining whether a "0" is to be embedded;
IF a "0" is to be embedded; THEN
setting the power of a tone at f_0 to a percentage of the power of f_e ;
setting the power of a tone at f_1 to a fraction of the power of said
tone at f_0 ;
embedding said tone at f_0 and said tone at f_1 into said frame of said
host audio signal;
transmitting said frame of said host audio signal;
inputting next frame of said host audio signal and next bit of said
digital signal to be embedded; and
returning to said step of determining;
OTHERWISE;
setting the power of a tone at f_1 to a percentage of the power of f_e ;
setting the power of a tone at f_0 to a fraction of the power of said
tone at f_1 ; and
returning to said step of embedding.

2. Method of claim 1, further comprising a steganographic method for recovering
embedded data, comprising the steps of:
receiving a digital audio signal containing an embedded digital signal;
dividing said received audio signal into non-overlapping frames;
computing the frame power f_e of each said non-overlapping frame of said
received digital host audio signal;

7 determining whether $(f_e / f_0) > (f_e / f_1)$
8 IF $(f_e / f_0) > (f_e / f_1)$, THEN
9 declaring the embedded bit to be a “0”; and
10 returning to said step of computing said frame power for the next
11 frame of said received digital host audio signal;
12 OTHERWISE,
13 declaring the embedded bit to be a “1”; and
14 returning to said step of computing said frame power for the next
15 frame of said received digital host audio signal.

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1 3. Method of claim 1, wherein said non-overlapping frames are 16 milliseconds in
2 length.

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1 4. Method of claim 2, wherein said non-overlapping frames are 16 milliseconds in
2 length.

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1 5. Method of claim 1, wherein

2 said power of said tone at f_0 is 0.25% the power of f_e ; and
3 said power of said tone at f_1 is 0.001 of the power of said tone at f_0
4 whenever a “0” is to be embedded.

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1 6. Method of claim 1, wherein

2 said power of said tone at f_1 is 0.25% the power of f_e ; and
3 said power of said tone at f_0 is 0.001 of the power of said tone at f_0
4 whenever a “1” is to be embedded.

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1 7. In the field of audio communication, a steganographic method for embedding two
2 bits of data, comprising the steps of:
3 a first step of inputting a digital host audio signal;
4 dividing said host audio signal into non-overlapping frames;
5 computing the frame power f_e ;

6 a second step of inputting a digital signal to be embedded;
7 a first step of determining whether a “00” is to be embedded;
8 IF a “00” is to be embedded; THEN
9 setting the power of a tone at f_0 to a percentage of the power of f_e ;
10 setting the power of tones at f_1 , f_2 and f_3 to a fraction of the power of said tone
11 at f_0 ;
12 embedding said tone at f_0 and said tones at f_1 , f_2 and f_3 into said frame of said
13 host audio signal;
14 transmitting said frame of said host audio signal;
15 inputting next frame of said host audio signal and next two bits of said digital
16 signal to be embedded; and
17 returning to said first step of determining;
18 OTHERWISE;
19 a second step of determining whether a “01” is to be embedded;
20 IF a “01” is to be embedded; THEN
21 setting the power of a tone at f_1 to a percentage of the power of f_e ;
22 setting the power of tones at f_0 , f_2 and f_3 to a fraction of the power of said
23 tone at f_1 ;
24 embedding said tone at f_1 and said tones at f_0 , f_2 and f_3 into said frame of
25 said host audio signal;
26 transmitting said frame of said host audio signal;
27 inputting next frame of said host audio signal and next two bits of said
28 digital signal to be embedded; and
29 returning to said first step of determining;
30 OTHERWISE;
31 a third step of determining whether a “10” is to be embedded;
32 IF a “10” is to be embedded; THEN
33 setting the power of a tone at f_2 to a percentage of the power of f_e ;
34 setting the power of tones at f_0 , f_1 and f_3 to a fraction of the power of
35 said tone at f_2 ;

36 embedding said tone at f_2 and said tones at f_0, f_1 and f_3 into said frame
37 of said host audio signal;
38 transmitting said frame of said host audio signal;
39 inputting next frame of said host audio signal and next two bits of said
40 digital signal to be embedded; and
41 returning to said first step of determining;
42 OTHERWISE;
43 a fourth step of determining whether a “11” is to be embedded;
44 IF a “11” is to be embedded; THEN
45 setting the power of a tone at f_3 to a percentage of the power of f_e ;
46 setting the power of tones at f_0, f_1 and f_2 to a fraction of the power of
47 said tone at f_3 ;
48 embedding said tone at f_3 and said tones at f_0, f_1 and f_2 into said
49 frame of said host audio signal;
50 transmitting said frame of said host audio signal;
51 inputting next frame of said host audio signal and next two bits of
52 said digital signal to be embedded; and
53 returning to said first step of determining.

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1 8. Method of claim 7, further comprising a steganographic method for recovering
2 embedded data, comprising the steps of:

3 receiving a digital audio signal containing an embedded digital signal;
4 dividing said received digital audio signal into non-overlapping frames;
5 computing the frame power f_e and the frame power at f_0, f_1, f_2 and f_3 of each non-
6 overlapping frame of said received digital audio signal;
7 computing the ratios $(f_e / f_0), (f_e / f_1), (f_e / f_2)$ and (f_e / f_3) ;
8 a first step of determining whether (f_e / f_0) is the lowest ratio;
9 IF (f_e / f_0) is the lowest ratio; THEN
10 declaring the embedded bits to be “00”; and
11 returning to said step of computing the frame power f_e and the frame power at
12 f_0, f_1, f_2 and f_3 of next frame of said received digital host audio signal;

13 OTHERWISE;

14 a second step of determining whether (f_e / f_1) is the lowest ratio;

15 IF (f_e / f_1) is the lowest ratio; THEN

16 declaring the embedded bits to be “01”; and

17 returning to said step of computing the frame power f_e and the frame

18 power at f_0, f_1, f_2 and f_3 of next frame of said received digital host audio

19 signal;

20 OTHERWISE;

21 a third step of determining whether (f_e / f_2) is the lowest ratio;

22 IF (f_e / f_2) is the lowest ratio; THEN

23 declaring the embedded bits to be “10”; and

24 returning to said step of computing the frame power f_e and the frame

25 power at f_0, f_1, f_2 and f_3 of next frame of said received

26 digital host audio signal;

27 OTHERWISE;

28 a fourth step of determining whether (f_e / f_3) is the lowest ratio;

29 IF (f_e / f_3) is the lowest ratio; THEN

30 declaring the embedded bits to be “11”; and

31 returning to said step of computing the frame power f_e

32 and the frame power at f_0, f_1, f_2 and f_3 of next frame of

33 said received digital host audio signal.

1 9. Method of claim 7, wherein said non-overlapping frames are 16 milliseconds in
2 length.

1 10. Method of claim 8, wherein said non-overlapping frames are 16 milliseconds in
2 length.

1 11. Method of claim 7, wherein
2 said power of said tone at f_0 is 0.05% the power of f_e ; and
3 said power of said tones at f_1 , f_2 and f_3 is 0.001 of the power of said tone at f_0

4 whenever a "00" is to be embedded.

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1 12. Method of claim 7, wherein

2 said power of said tone at f_1 is 0.05% the power of f_e ; and

3 said power of said tones at f_0 , f_2 and f_3 is 0.001 of the power of said tone at f_1
4 whenever a "01" is to be embedded.

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1 13. Method of claim 7, wherein

2 said power of said tone at f_2 is 0.05% the power of f_e ; and

3 said power of said tones at f_0 , f_1 and f_3 is 0.001 of the power of said tone at f_2
4 whenever a "10" is to be embedded.

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1 14. Method of claim 7, wherein

2 said power of said tone at f_3 is 0.05% the power of f_e ; and

3 said power of said tones at f_0 , f_1 and f_2 is 0.001 of the power of said tone at f_2
4 whenever a "11" is to be embedded.